



Australian Government  
Geoscience Australia



# Integrating Landsat 5 and Landsat 7 to create Landsat time series

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# NBAR correction

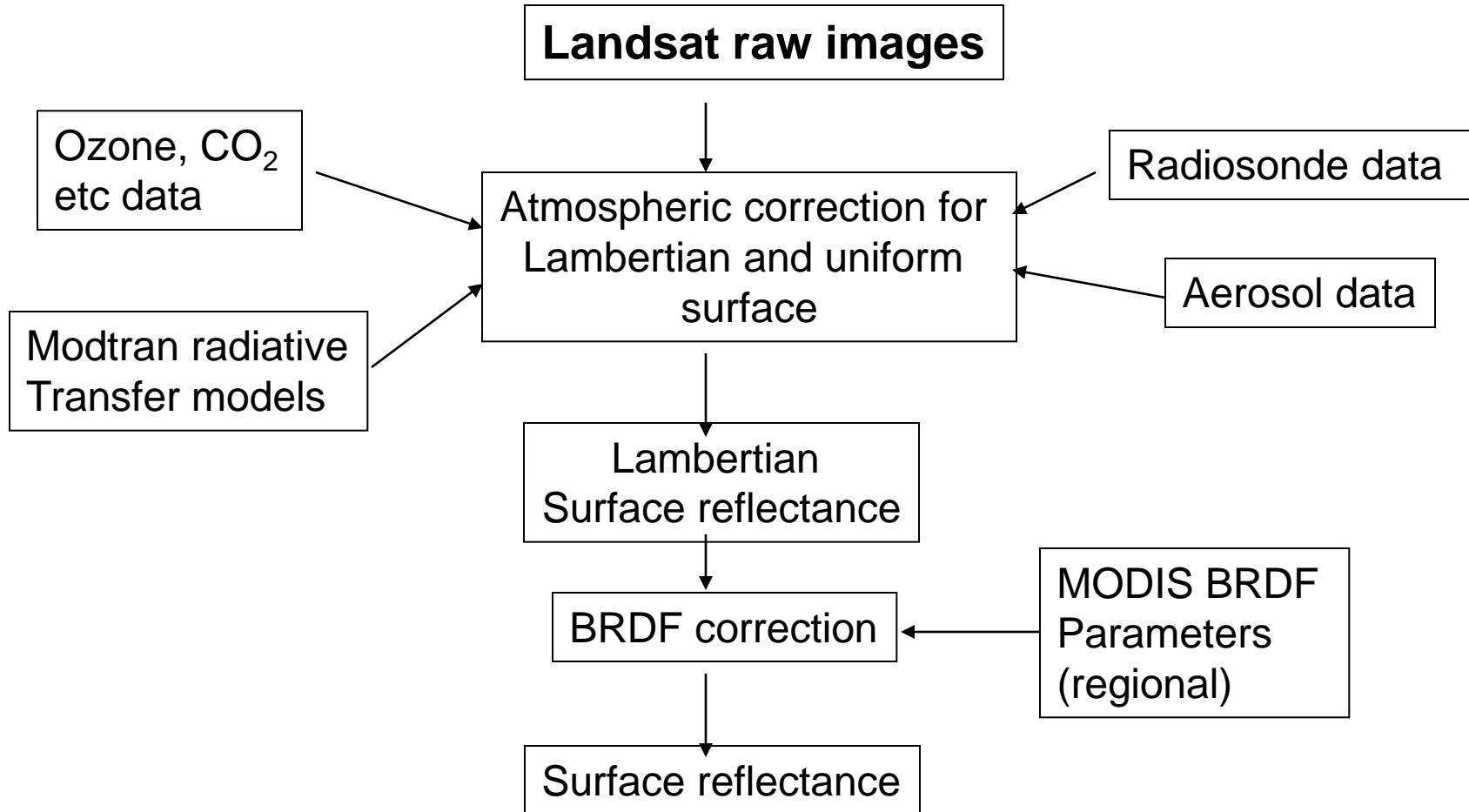
N = Nadir view (viewed from above)

B = Bidirectional Reflectance Distribution Function (sun sensor geometry)

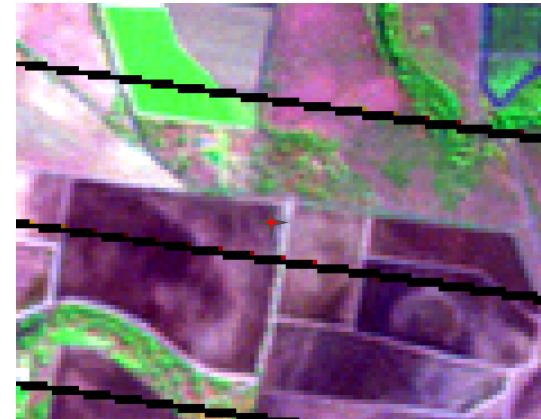
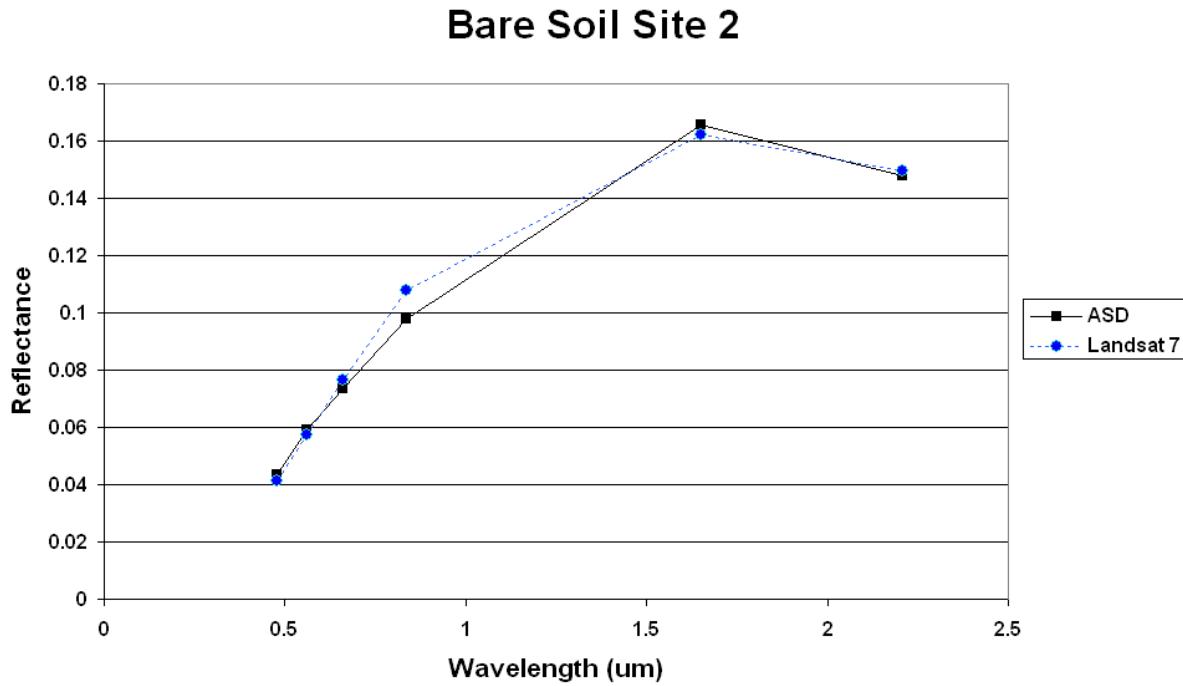
A = Atmospheric Correction (smoke, haze, water vapour)

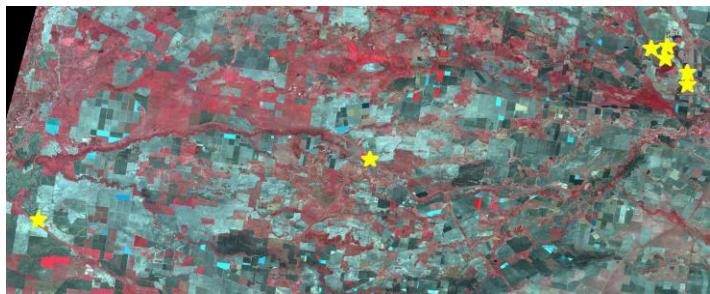
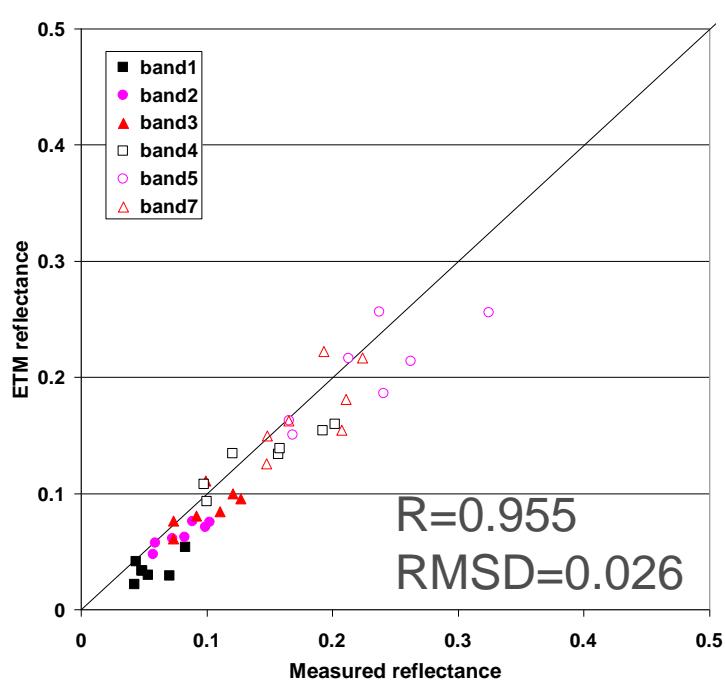
R = Reflectance (what you get once you've corrected the other influences)

# NBAR Correction Algorithm

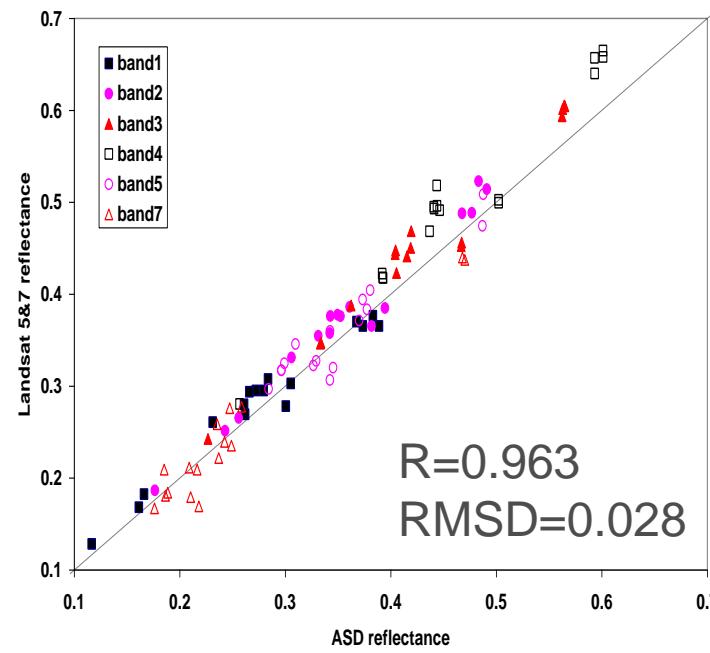
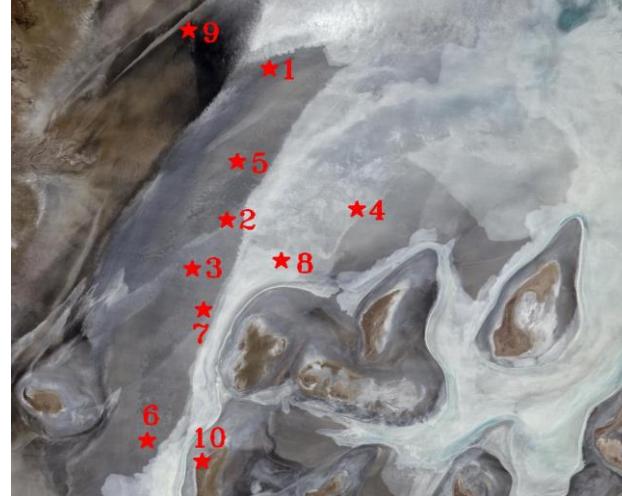


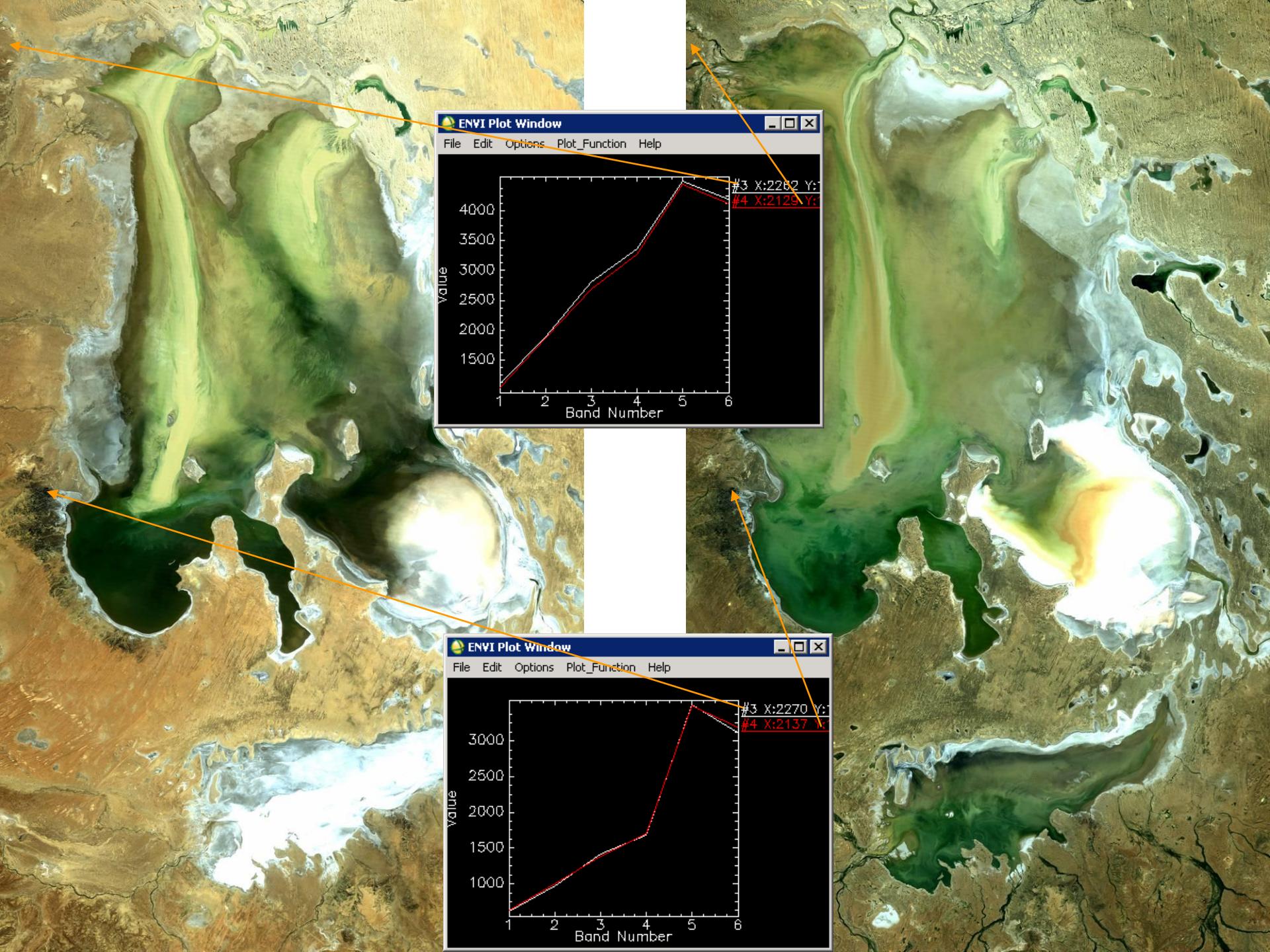
# Validating the NBAR Correction Algorithm





Li et al. IEEE JSTARS 3(3) 257-270



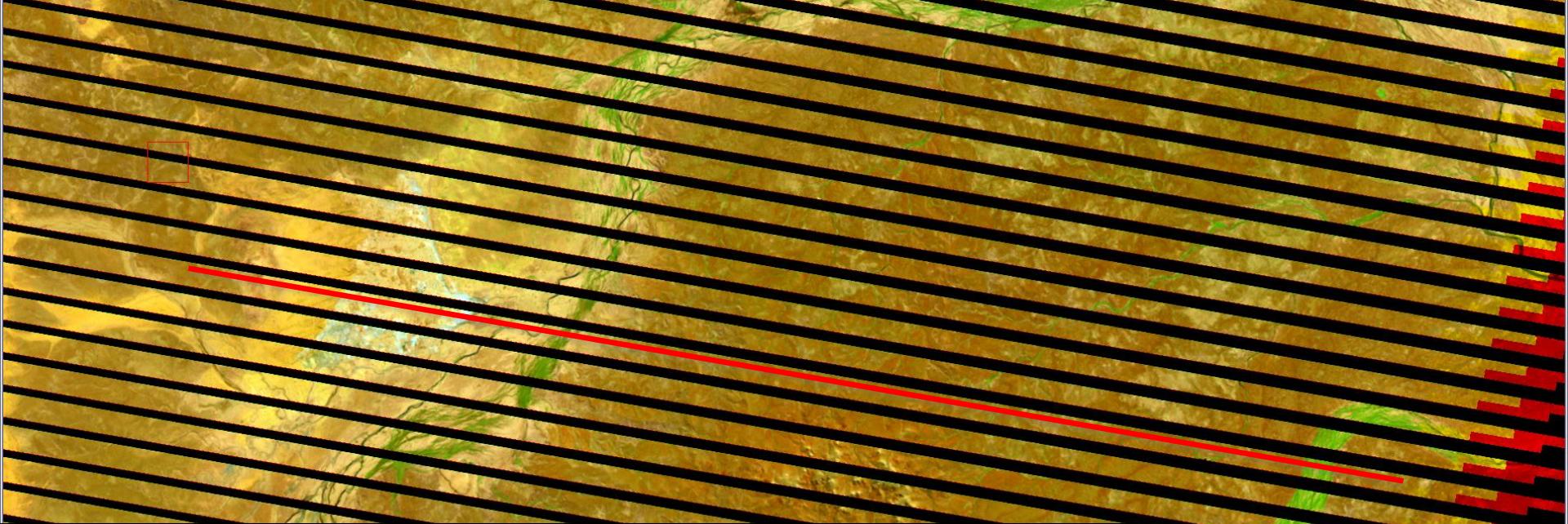


# That's great....but what about comparing observations between sensors?

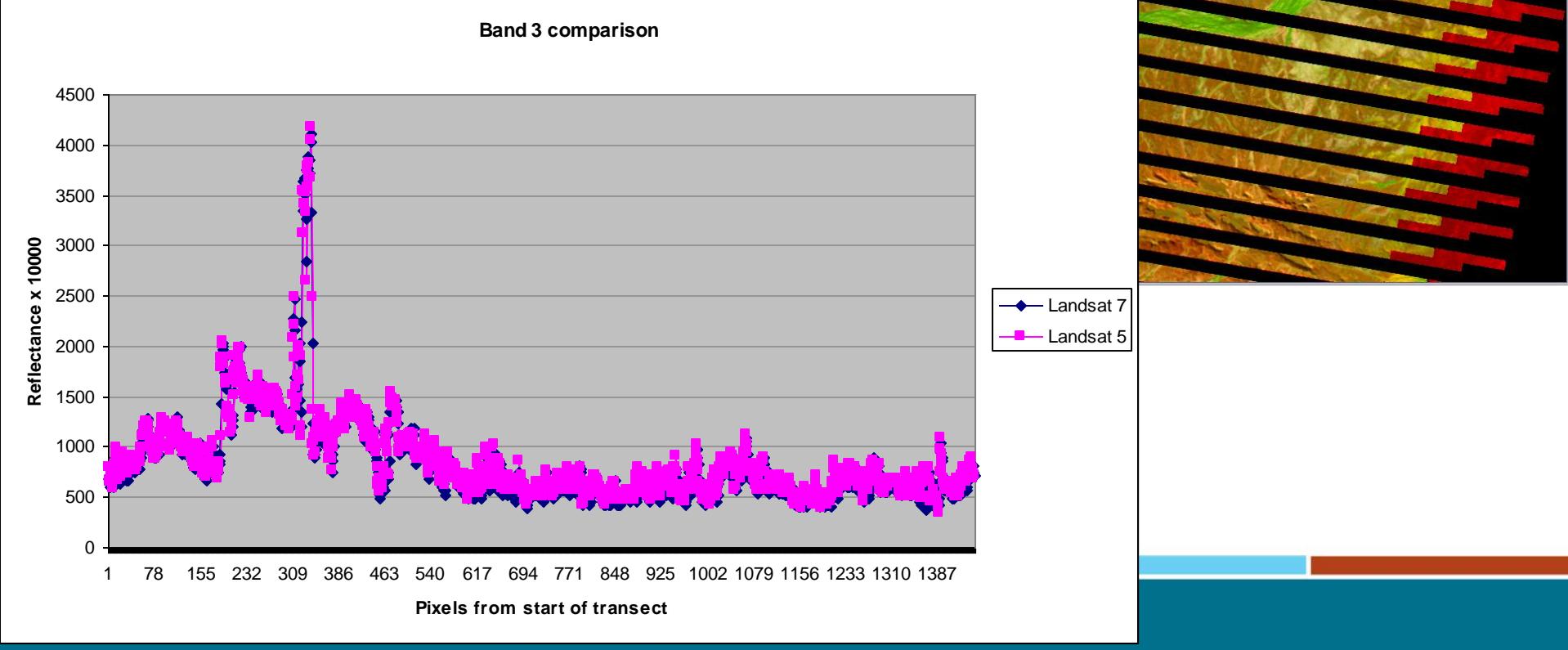
In the side lap between adjacent paths Landsat 5 and 7 observe the same location within 24 hours...

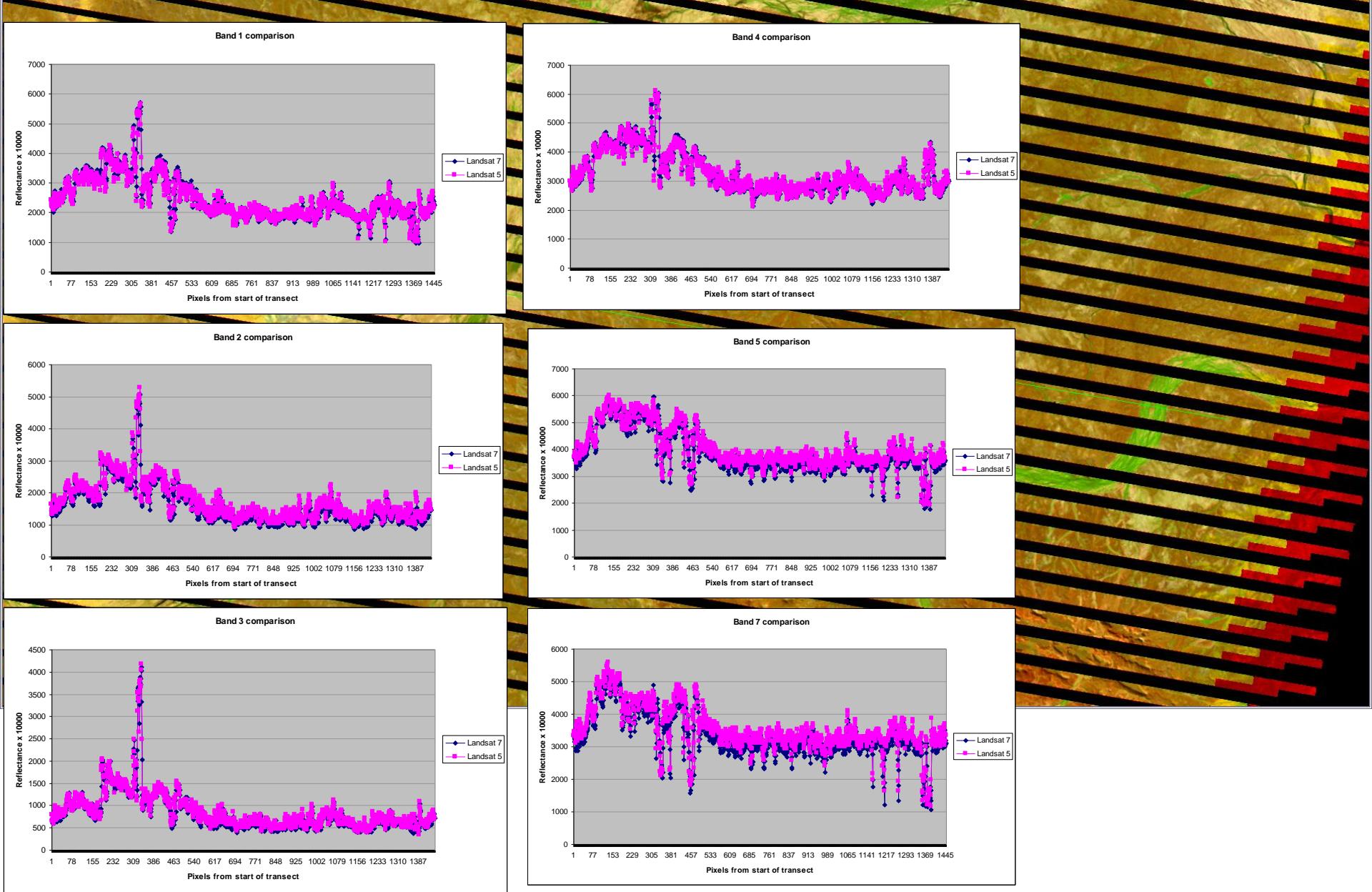
Assuming that the land surface has not changed within 24 hours it's possible to compare surface reflectance measurements from the two sensors

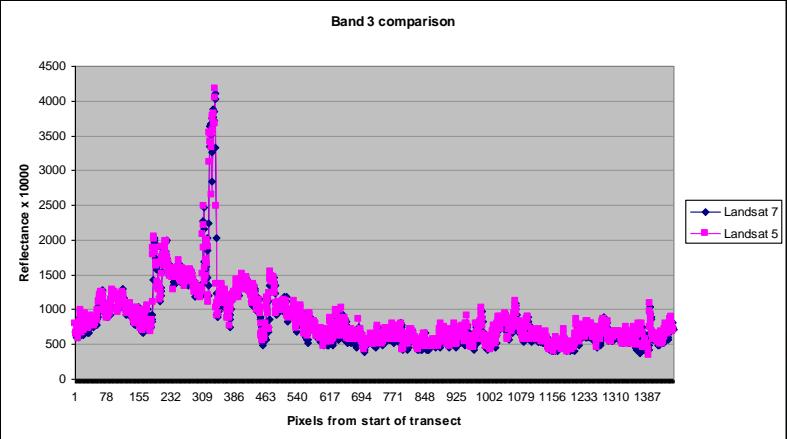
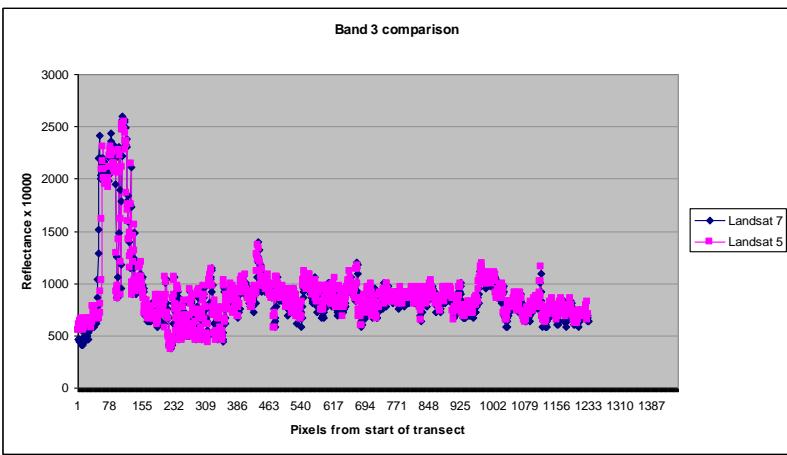
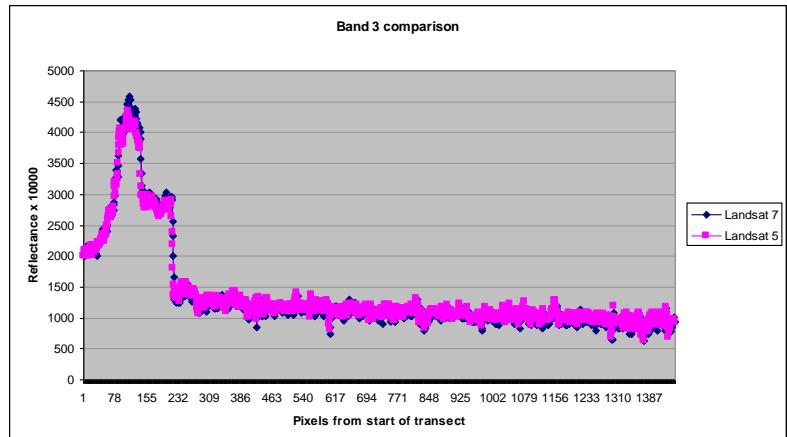
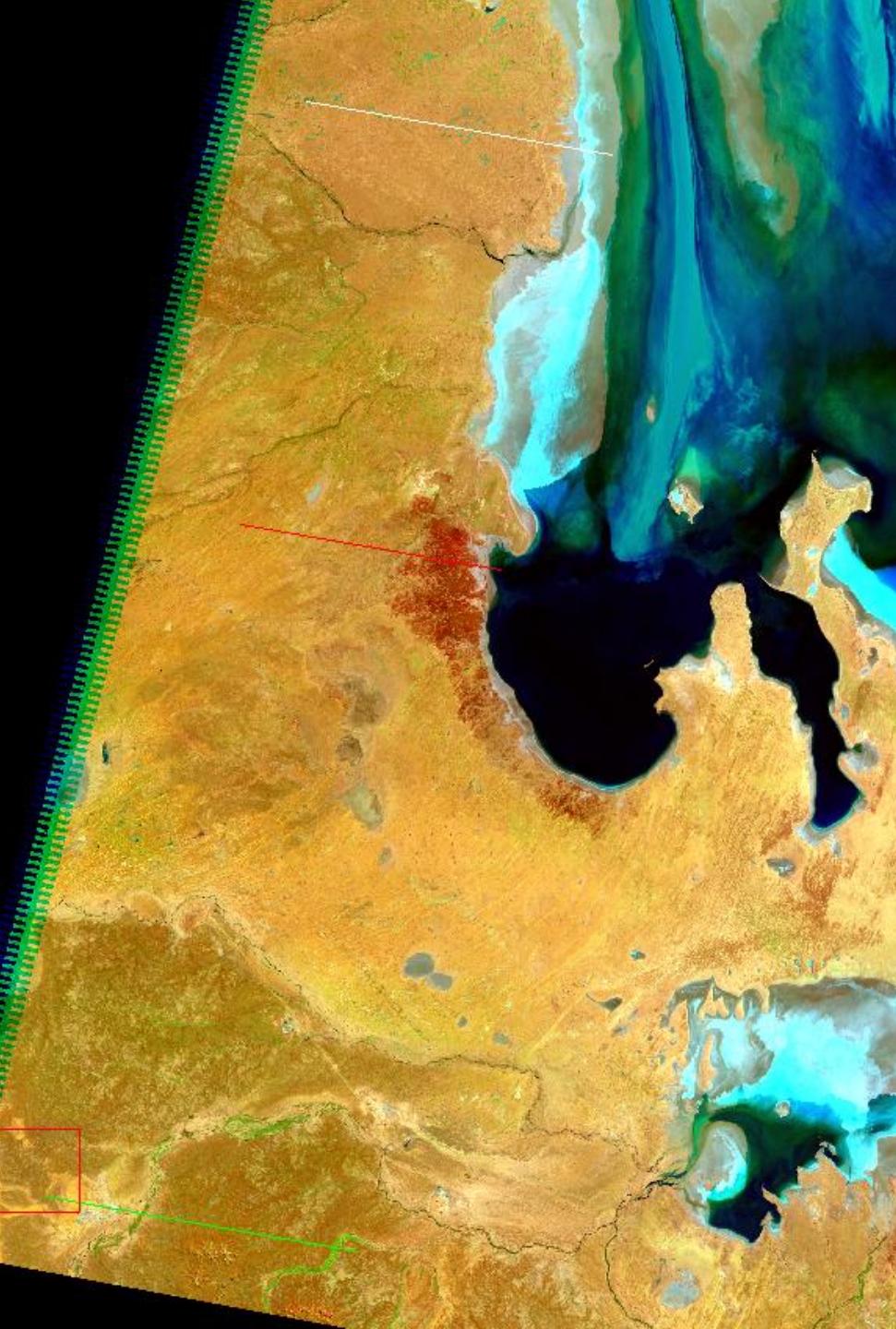
Provided you contend with the SLC off gap issue



Band 3 comparison



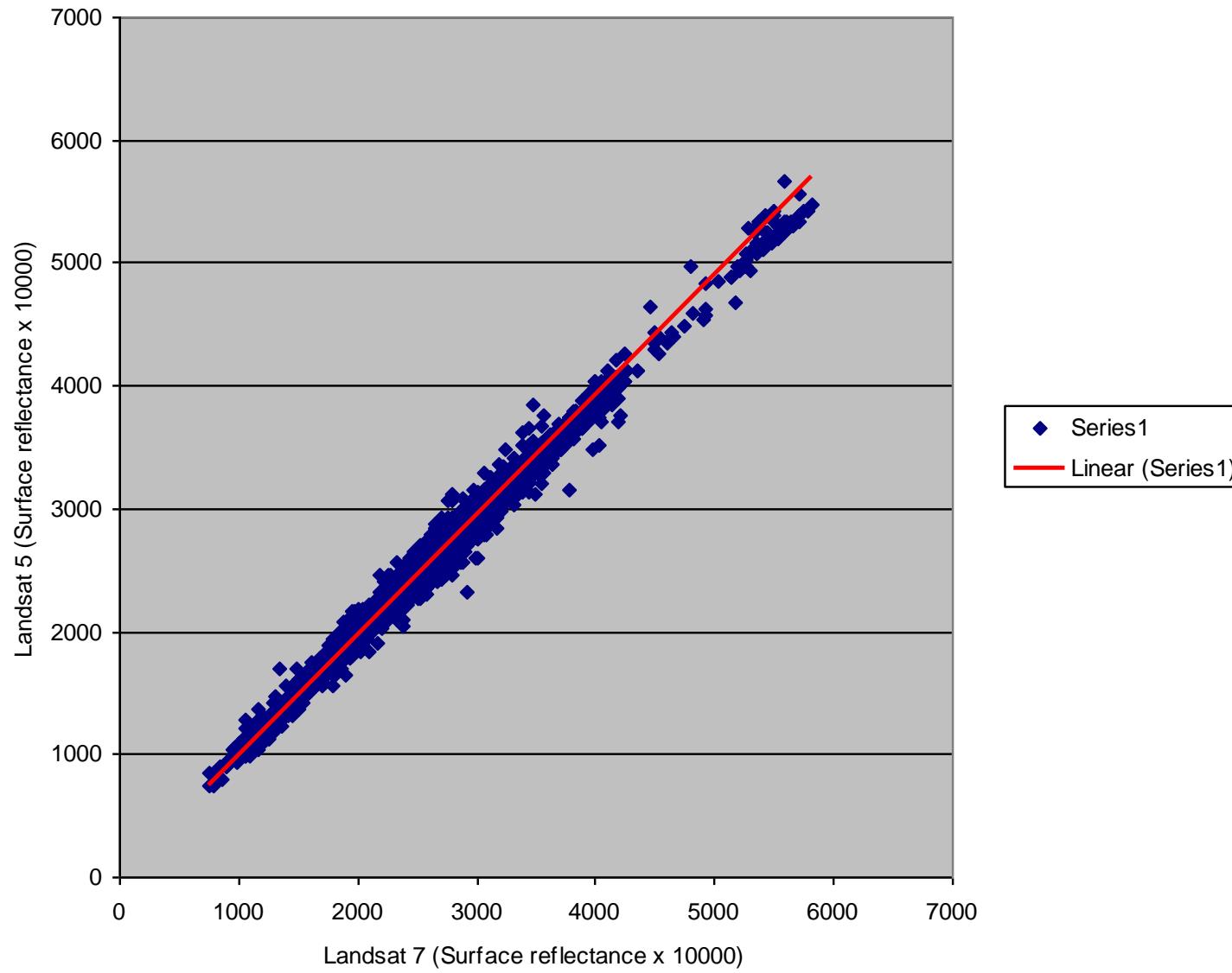


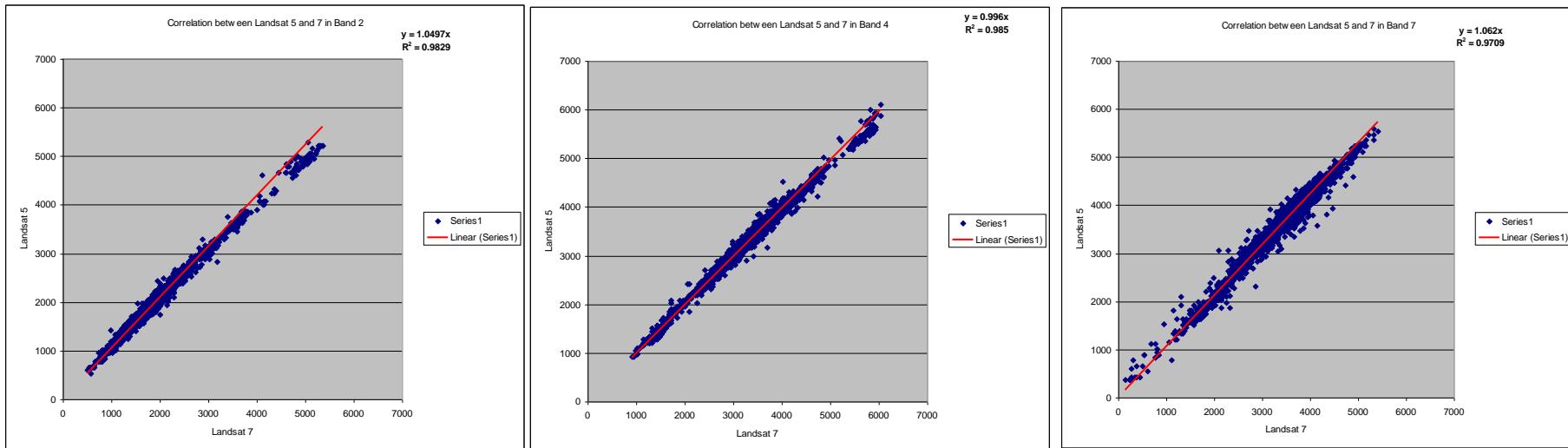
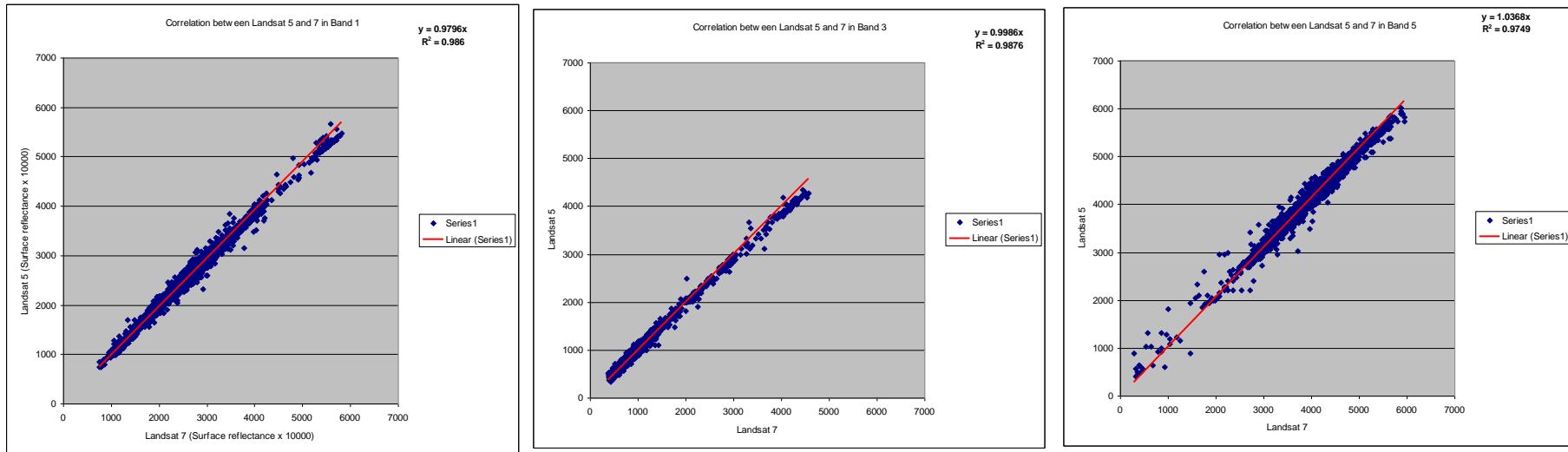


### Correlation between Landsat 5 and 7 in Band 1

$$y = 0.9796x$$

$$R^2 = 0.986$$





# Pixel Quality (PQ) band

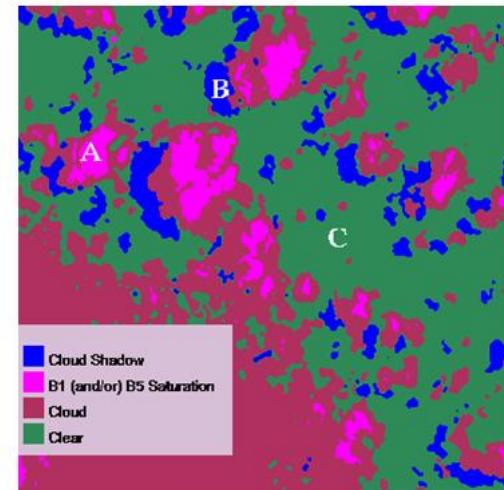
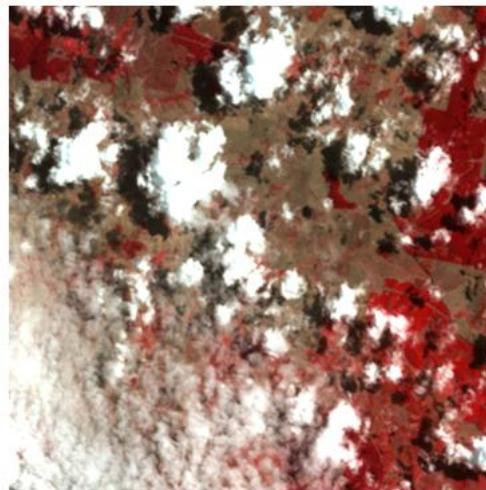
16-bit PQ band

Test	Bit	Value	Cumulative Sum
Saturation band 1	0	1	1
Saturation band 2	1	2	3
Saturation band 3	2	4	7
Saturation band 4	3	8	15
Saturation band 5	4	16	31
Saturation band 61*	5	32	63
Saturation band 62*	6	64	127
Saturation band 7	7	128	255
Contiguity	8	256	511
Land/Sea	9	512	1023
ACCA	10	1024	2047
Fmask	11	2048	4095
Cloud Shadow (ACCA)	12	4096	8191
Cloud Shadow (Fmask)	13	8192	16383
Topographic Shadow *	14	16384	32767
To be determined *	15	32786	65535

\* Designed to match Landsat 7 ETM+. The thermal band for Landsat 5 TM will correspond to band 61, and the result is duplicated into band 62.

\*\* Currently not set. A method for calculating topographic shadow has been developed, and will be added to the PQ. A final 16<sup>th</sup> test has yet to be investigated and developed.

PQ is currently produced for both Landsat 5 TM and Landsat 7 ETM+ L1T products.



False colour (4,3,2) RGB image and the corresponding PQ band. In this picture all saturated pixels are also cloudy pixels. The binary representation of the cumulative sum indicates a pass (1) or fail (0) for each quality test (reads right to left).

A: 001100111101110 (13294)

Bands 1 & 5 are saturated; both ACCA and Fmask detected cloud.

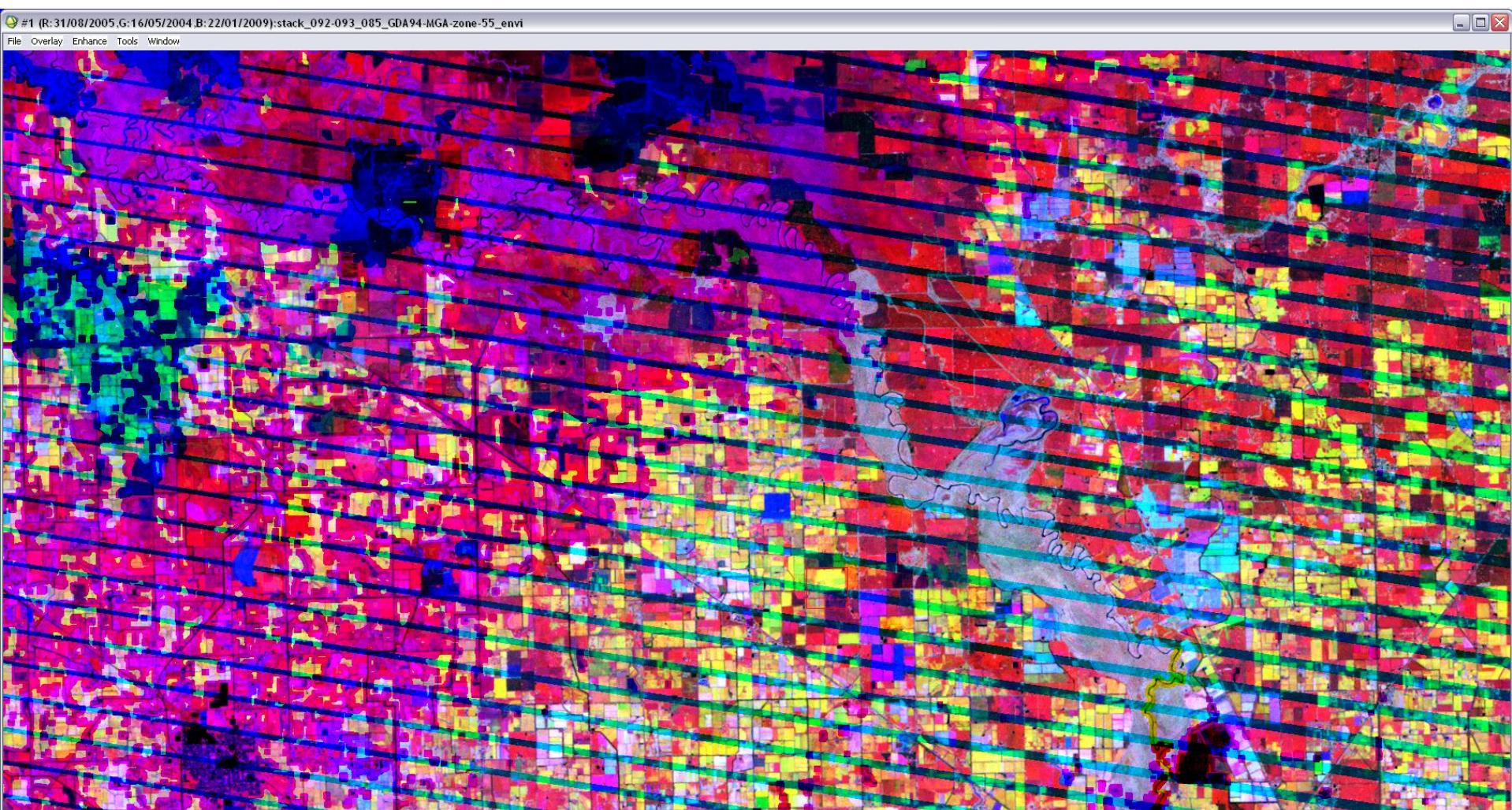
B: 000011111111111 (4095)

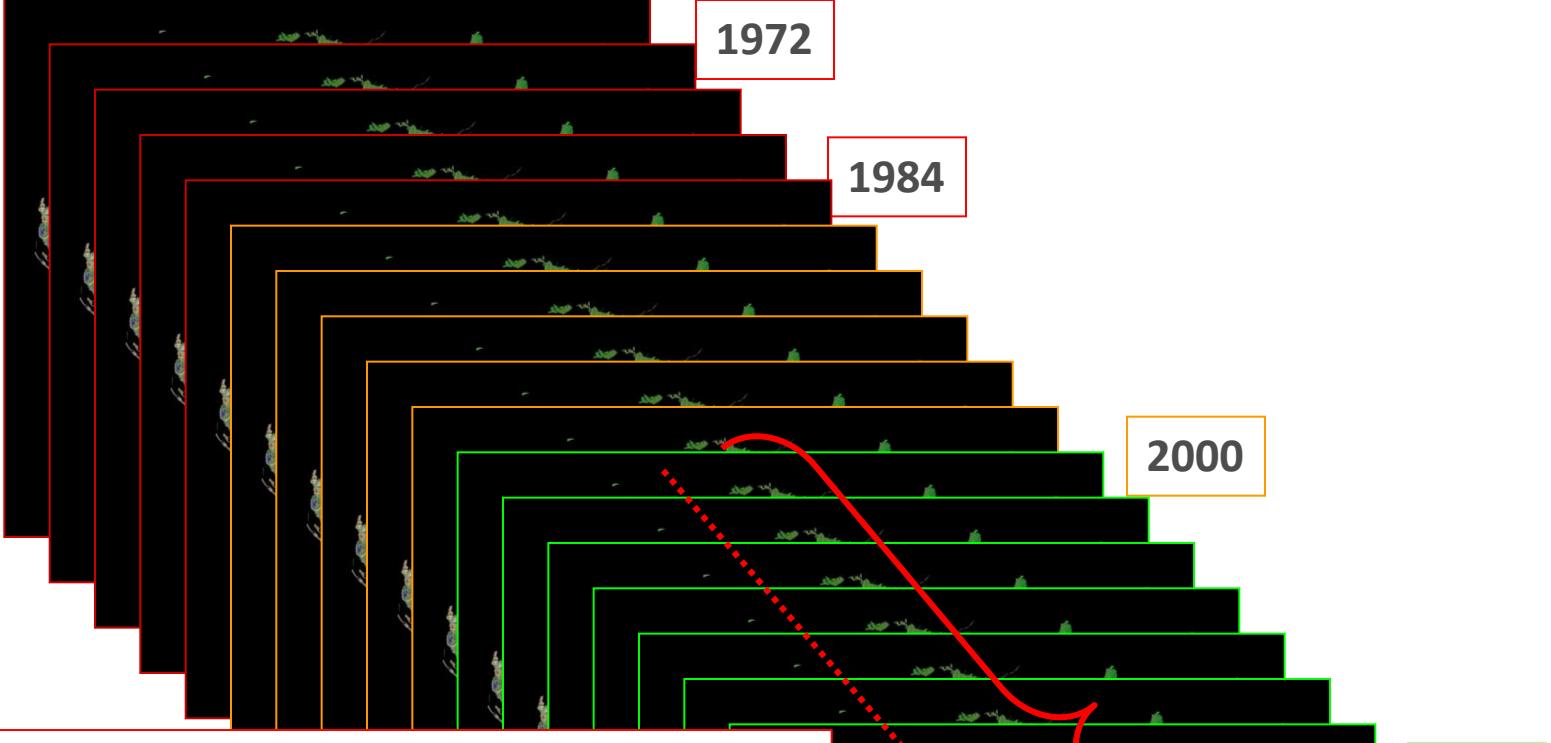
Cloud shadow detected, all other tests passed.

C: 001111111111111 (16383)

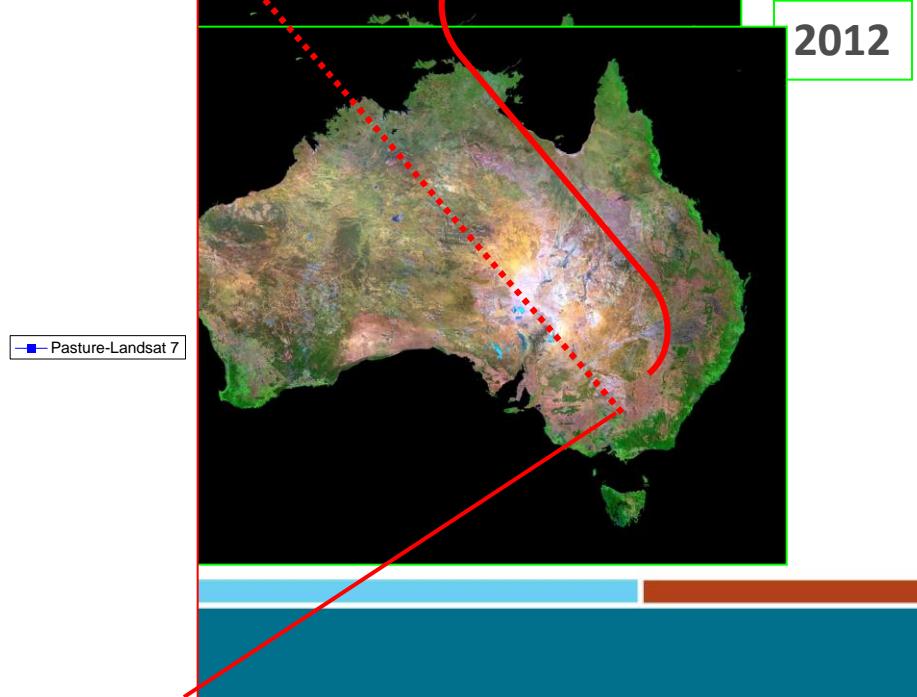
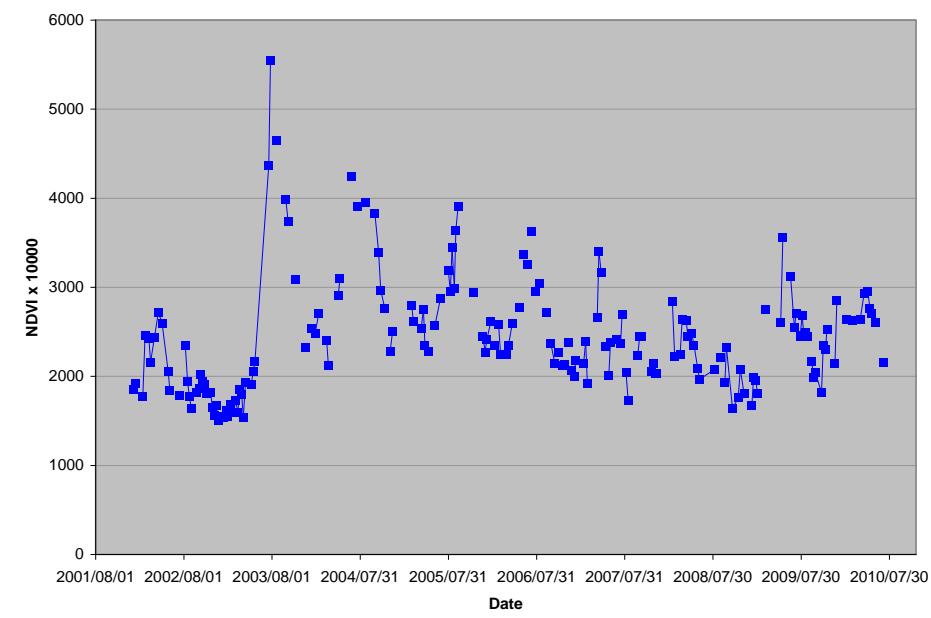
Pixel is clear, all tests passed.

# Combining Landsat 5 and 7 to create NDVI time series

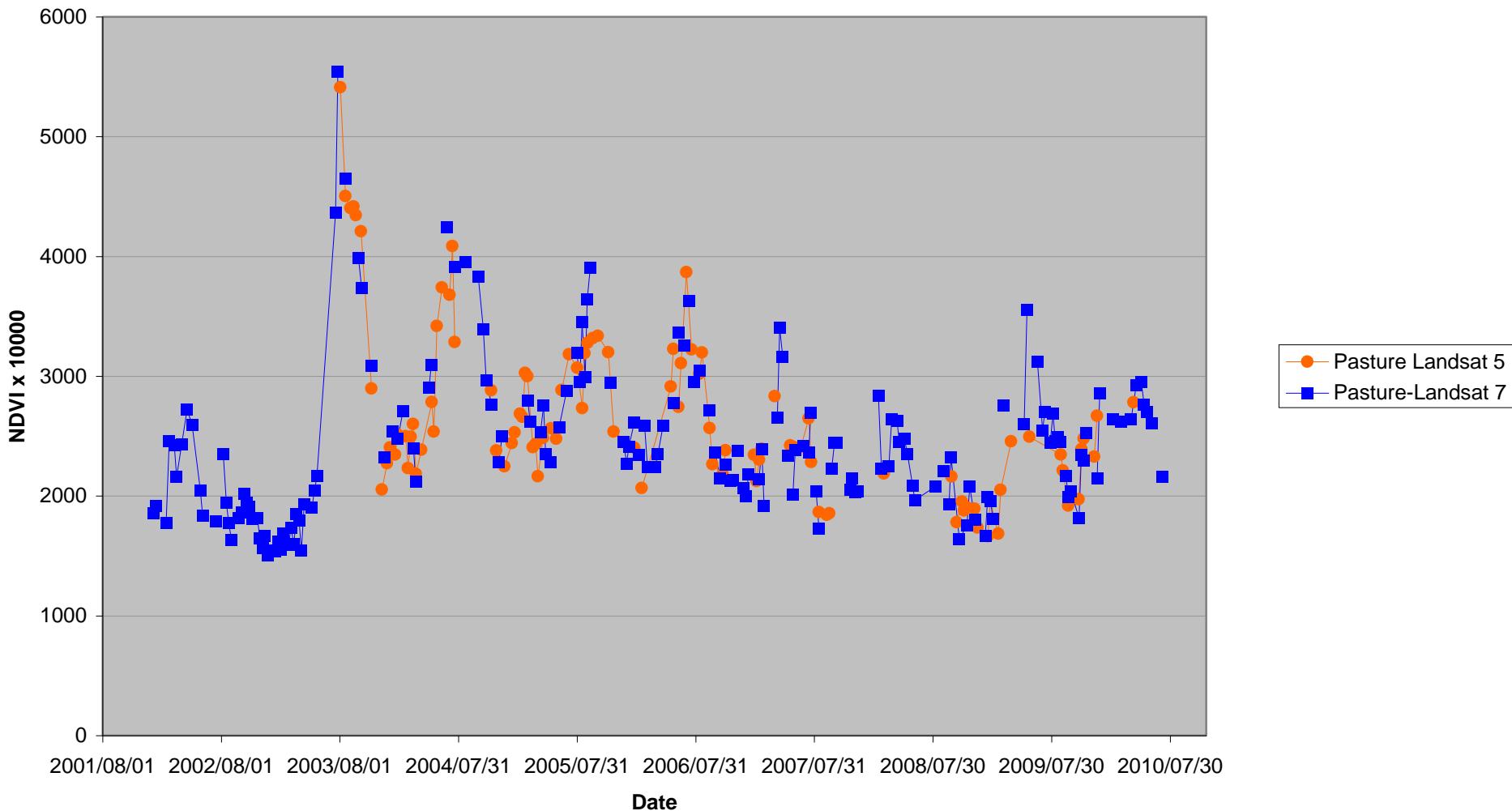




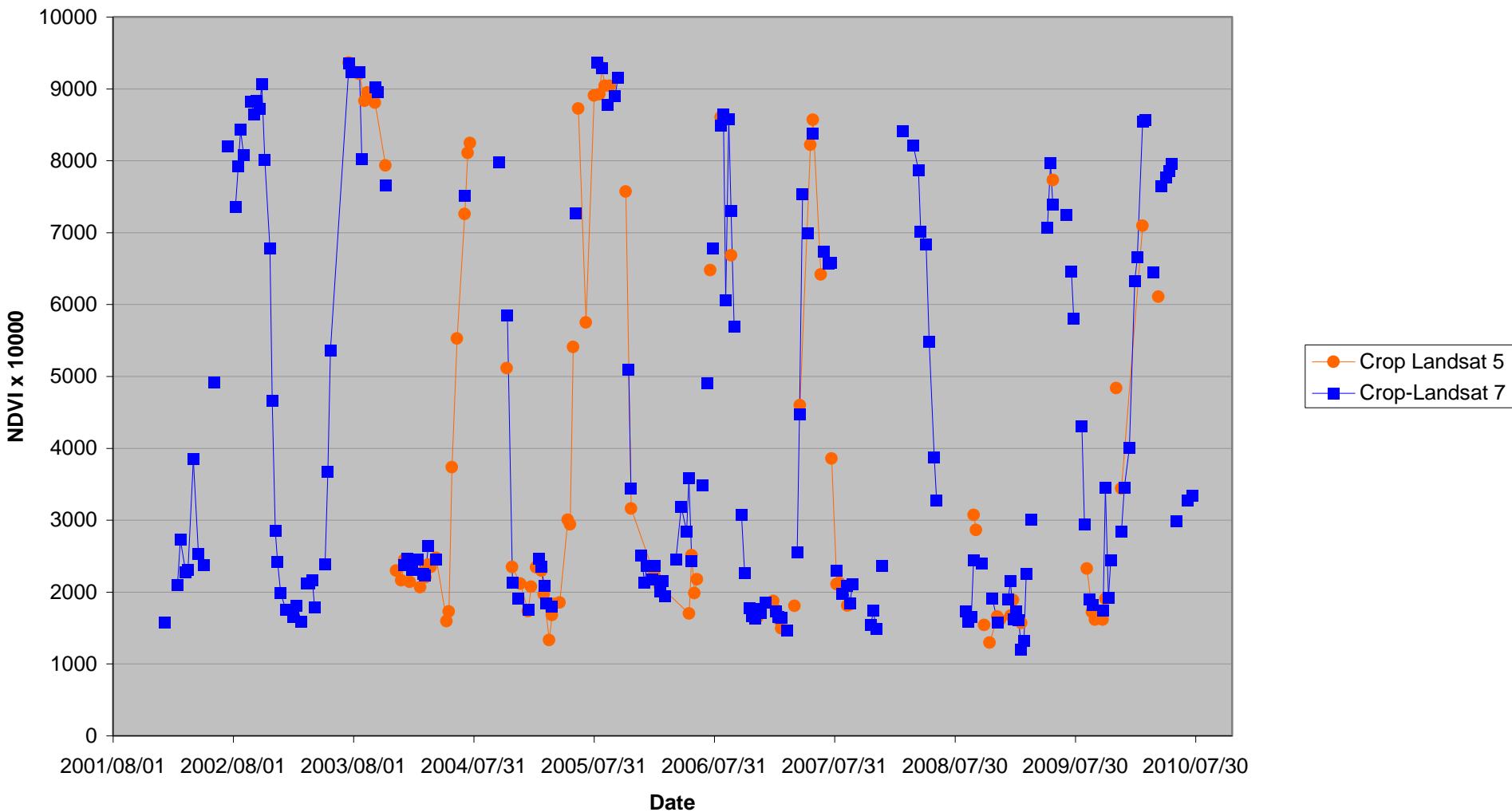
Landsat Time Series for rain fed pasture in Victoria (Landsat 7)



## Landsat Time Series for rain fed pasture in Victoria (Combining Landsat 5 and 7)



## Landsat Time Series for rain fed cropping in Victoria (Combining Landsat 5 and 7)



### Landsat time series for different land covers

